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(71) Applicant *(for all designated States except US)*: FIBERWEB NORTH AMERICA, INC. [US/US]; 840 S.E. Main Street, Simpsonville, SC 29681 (US).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: QUANTRILLE, Thomas, E. [US/US]; 304 Walker Way, Simpsonville, SC 29681 (US).

(74) Agents: LINKER, Raymond, O., Jr. et al.; Bell, Seltzer, Park & Gibson, P.O. Drawer 34009, Charlotte, NC 28234 (US).

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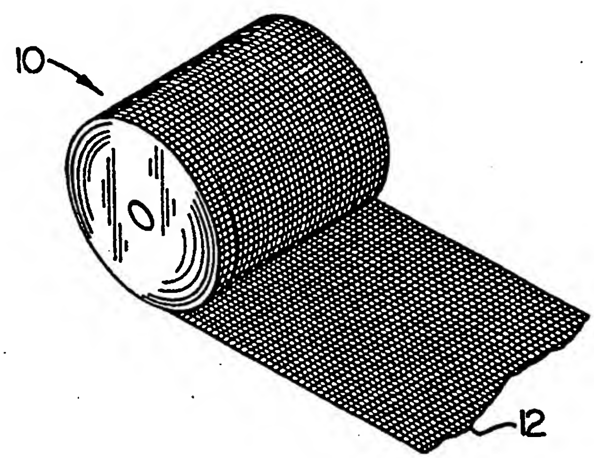
(54) Title: COMPOSITE ELASTIC NONWOVEN FABRIC

(57) Abstract

The invention provides composite elastic nonwoven fabrics and the process of making them. The elastic nonwoven composite fabrics of the invention are formed from the combination of a plurality of cooperative elastic layers including an elastomeric fibrous layer and an elastomeric net layer which has increased elastic properties as compared to the elastomeric fibrous layer. The plural elastomeric layers are joined together in a unitary elastic fabric structure to provide a composite having a desirable combination of different elastic properties. Advantageously the elastic nonwoven composites of the invention are fabrics formed from the combination of an elastomeric net and one or more elastomeric fibrous spunbond or meltblown webs. The elastomeric net component imparts desirable strength and recovery properties to the composite fabric while the elastomeric fibrous web imparts desirable cover, barrier, and/or porosity properties to the composite.



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COMPOSITE ELASTIC NONWOVEN FABRIC

Field of the Invention

The invention relates to composite elastic nonwoven fabrics and to processes for producing them. More specifically, the invention relates elastic to nonwovens having desirable strength, conformability, aesthetic, and stretch and recovery properties, and which can be readily manufactured using existing textile equipment.

Background of the Invention

Nonwoven elastic fabrics have been the subject of considerable attention and effort. Elastic fabrics are desirable for use in bandaging materials, garments, diapers, supportive clothing and personal hygiene products because of their ability to conform to irregular shapes and to allow more freedom of body movement than fabrics with limited extensibility.

Elastomeric materials have been incorporated into various fabric structures to provide stretchable fabrics. In many instances, such as where the fabrics are made by knitting or weaving, there is a relatively high cost associated with the fabric. In cases where the fabrics are made using nonwoven technologies, the fabrics can suffer from insufficient strength and/or only limited stretch and recovery properties.

Elastic nonwoven webs have been produced by meltblowing of elastomers. This involves melting the

elastomer in an extruder and feeding the molten resin to a melt-blowing die having a plurality of linearly arranged small diameter capillaries. The resin emerges from the die orifices as molten threads into a high velocity stream of gas, usually air. The air attenuates the polymer into a blast of fine fibers which are collected on a moving screen placed in front of the blast. As the fibers land on the screen, they entangle to form a cohesive web. Meltblowing can form very small diameter fibers, typically about two micrometers in diameter and several inches in length.

Meltblown elastomeric webs are only moderately strong because the meltblowing process is normally conducted using relatively low molecular weight, and relatively high melt flow rate polymers. In addition, elastomeric meltblown webs are only moderately elastic for similar reasons. These deficiencies in elasticity can be seen in relatively high creep, i.e., the time dependent increase in elongation when the web is subjected constant stress; and also in relatively high stress relaxation, i.e., the time dependent loss of retractive power when the web is held in a stretched condition.

Similar deficiencies in strength and in elastic properties are also apparent in other nonwoven elastic fabrics. Low strength is objectionable because low strength elastic fabrics are apt to tear when stretched significantly. Creep and stress relaxation properties are also highly significant. For example, in elastic garments, personal hygiene products, diapers, and other products intended to conform to various body parts, high creep and stress relaxation properties can result in the loss of conformability and elastic recovery during use of the product. This is particularly true when the product is stretched significantly and/or stretched and heated during use,

as can happen when stretched products are contacted with body fluids.

Many elastomeric nonwoven fabrics also suffer from poor aesthetics. Elastomers often have an undesirable rubbery feel. As a result, elastomeric nonwoven fabrics often have a hand and texture that is perceived by the user as sticky or rubbery and therefore undesirable.

Due in part to the shortcomings in strength, elasticity, and aesthetics, substantial effort has been directed to the formation of composite elastic nonwovens by combining elastomeric nonwoven fabrics with other fabrics. These include fabrics having a more desirable hand for improving aesthetics of the elastomeric nonwoven, and fabrics having greater strength for protecting the elastomeric nonwoven from being overly stretched to a condition where elastic properties or fabric integrity are lost.

U.S. Patent 4,775,579 to Hagy, et al. discloses desirable composite elastic nonwoven fabrics containing staple textile fibers intimately hydroentangled with an elastic web or an elastic net. One or more webs of staple textile fibers and/or wood pulp fibers can be hydroentangled with an elastic net according to the disclosure of this invention. The resulting composite fabric exhibits characteristics comparable to those of knit textile cloth and possesses superior softness and extensibility properties. The rubbery feel traditionally associated with elastomeric materials can be minimized or eliminated in these fabrics.

U.S. 4,413,623 to Pieniak discloses a laminated structure such as a disposable diaper which can incorporate an elastic net into portions of the structure. The elastic net can be inserted in a stretched condition between first and second layers of the structure and bonded to the layers while in the

stretched condition. Subsequent relaxation of the elastic net can result in gathering of the structure.

U.S. 4,525,407 to Ness discloses elastic fabrics which include an elastic member, which may be an elastic net, intermittently bonded to a substrate which prior to stretching is less easily extensible than the elastic member. The nonelastic member is bonded to the elastic member and the entire composite is rendered elastic by stretching and relaxation.

U.S. 4,606,964 to Wideman discloses a bulked composite web which can be prepared by bonding a gatherable web to a differentially stretched elastic net. Subsequent relaxation of the differentially stretched net is said to result in gathering of the fabric.

These and other elastic nonwoven fabrics and the processes for manufacturing them suffer from various disadvantages. The lamination of webs and nets formed from thermoplastic elastomers to other fabrics under tension can be extremely difficult. Small changes in tension during manufacture can result in stretching or recovery of the fabric which can lead to a non-uniformly manufactured product. This is particularly true when heating is required, for example, during adhesive application, lamination, thermal bonding or other thermal treatment. In addition, thermoplastic elastomers can lose elastic properties when stressed at elevated temperatures and allowed to cool fully or partially while stressed, and/or the thermoplastic fibers and filaments can break, resulting in an elastic fabric with minimal elastic properties.

Moreover, when relaxation with concomitant gathering is used as the basis for stretch in the final composite, the resultant fabric often has an excessive thickness which can also be aesthetically objectionable. And in many instances, the final fabric

exhibits a low extensibility which is well below the possible extensibility afforded by the elastomeric component.

Summary of the Invention

The invention provides composite elastic nonwoven fabrics which exhibit improved strength, elastic, and aesthetic properties. Composite fabrics provided according to the invention can have a high degree of elastic stretch, while problems of insufficient strength, insufficient retention of elastic properties during fabric use, and excessive fabric thickness, can be minimized or eliminated. In various embodiments, nonwoven elastic fabrics of the invention can exhibit desirable hand, cover and barrier characteristics. The fabrics of the invention can be readily manufactured while many of the difficulties associated with manufacturing of prior art composite elastic fabrics are avoided.

The elastic nonwoven composite fabrics of the invention are formed from the combination of a plurality of cooperative elastomeric layers including an elastomeric fibrous layer and an elastomeric net layer which has different elastic properties as compared to the elastomeric fibrous layer. Typically the net has higher strength, higher elastic recovery, lower stress relaxation and/or lower creep than the elastomeric fibrous layer. The plural elastomeric layers are joined together into a unitary elastic fabric structure to provide a composite having a desirable combination of elastic properties. The elastomeric net component imparts desirable strength, stretch, and recovery properties to the composite fabric. The elastomeric fibrous web imparts desirable cover, barrier, and/or porosity properties to the composite, both when the fabric is relaxed and when it is stretched. Because the component layers used to form the composites of the invention are elastic

structures, no stretching and subsequent relaxation are required to impart elastic properties to the composite.

In one advantageous embodiment of the invention, one or more elastomeric meltblown fabric layers are combined with an elastomeric net. The resulting composite has the desirable stretch, barrier and cover properties of an elastomeric meltblown and also has strength and recovery properties not previously available from elastic meltblowns, which previously have been subject to tearing and/or rupture when subjected to significant forces, or have been reinforced with other materials which significantly limit extensibility and often greatly increase fabric thickness. The composite nonwoven elastic net/elastic meltblown fabrics of the invention can be manufactured by relatively simple and straightforward manufacturing processes which involve forming at least one elastomeric meltblown layer directly on a preformed elastomeric net. The elastomeric meltblown can be formed onto one side of the elastomeric net and onto both sides. In the process of meltblowing onto the net, the meltblown fibers self-bond to themselves and the net. No post bonding or calendering is required.

The elastomeric net/elastomeric meltblown composite fabrics of the invention can be viewed as an elastic fibrous composite with a corresponding elastic reinforcing scrim. The elastic meltblown layer provides coverage with elasticity, and the elastic net layer provides structural integrity while maintaining elasticity and recovery. Importantly, neither the coverage layer nor the reinforcing scrim layer reduce elasticity; instead both layers are highly elastic.

In another advantageous embodiment of the invention, one or more elastomeric spunbond fabric layers are joined to an elastomeric net to provide a composite elastic nonwoven fabric of improved stretch and hand. The elastomeric spunbond layer or layers can

be joined to the elastomeric net by a thermal or adhesive bonding process. Preferably, joining of the net and spunbond elastomeric layers is accomplished by point bonding using heat and pressure with a calender. One preferred fabric according to this embodiment of the invention is a fabric of the structure: elastomeric spunbond/elastomeric net/elastomeric spunbond. The elastomeric spunbond/elastomeric net composites of the invention can provide good extensibility and good hand from the elastomeric spunbond layer, while the elastomeric net layer provides good recovery. Nonwoven composites made from these materials have stretch in both directions, with no need to laminate additional materials of low extensibility. In prior art fabrics, materials of low extensibility (e.g., spunbond polypropylene) have typically been required in the elastic composite to provide the composite with a soft, aesthetically pleasing hand.

The composite elastic fabrics of the invention provide improved and different elastic properties as compared to numerous prior art fabrics. Fabrics according to the invention can be used in personal care and hygiene products, diapers, disposable training pants, bandages, disposable medical and industrial garments and in industrial products such as for filtration. Fabrics of the invention can be provided with controllable filtration properties such that filtration ability can be changed simply by varying elongation of the fabric. This can be extremely useful in industrial systems because as a filter becomes clogged from trapped particulates, the fabric can be slightly elongated and used for a longer time. The fabrics of the invention avoid manufacturing complexities associated with many prior art fabrics. Thus the fabrics of the invention in many cases can lower the costs and substantially improve manufacturing

efficiencies previously associated with composite elastic fabrics.

Brief Description of the Drawings

In the drawings which form a portion of the original disclosure of the invention:

Figure 1 illustrates in perspective view an elastomeric net in roll form which can be used in producing fabrics of the invention;

Figure 2 schematically illustrates one preferred method and apparatus for manufacturing one preferred composite elastic nonwoven web from the combination of meltblown elastomeric layers and an elastomeric net according to the invention;

Figure 3 is a fragmentary cross-sectional view taken along line 3-3 of Figure 2 and schematically illustrates the structure of the composite formed according to the process of Figure 2 and shows strands of an elastomeric net contained within the fibrous structure of meltblown elastomeric webs;

Figure 4 schematically illustrates one preferred method and apparatus for manufacturing another preferred composite elastic nonwoven fabric of the invention from the combination of spunbond elastomeric layers and an elastomeric net; and

Figure 5 is a fragmentary cross-sectional view taken along line 5-5 of Figure 4 and schematically illustrates the structure of the composite formed according to the process of Figure 4 and shows strands of an elastomeric net sandwiched between spunbond elastomeric webs and also illustrates point bonding zones where the layers are thermally joined together.

Detailed Description of the Invention

In the following detailed description of the invention, specific preferred embodiments of the invention are described to enable a full and complete understanding of the invention. It will be recognized that it is not intended to limit the invention to the

particular preferred embodiments described, and although specific terms are employed in describing the invention, such terms are used in the descriptive sense for the purpose of illustration and not for the purpose of limitation. It will be apparent that the invention is susceptible to variation and changes within the spirit of the teachings herein.

The various fibrous and other nonwoven fabric and/or sheet layers used in this invention for forming the composite fabrics of this invention are elastomeric layers having elastic properties. As used herein and only for purposes of this application, the term "elastomeric" is used with reference to nonwoven layers, to mean nonwoven layers, including nets, fabrics or webs capable of substantial recovery, i.e. greater than about 75%, preferably greater than about 90% recovery, when stretched in an amount of about 30% at room temperature expressed as:

$$\% \text{ recovery} = (L_s - L_r)/(L_s - L_o) \times 100$$

where: L_s represents stretched length; L_r represents recovered length measured one minute after recovery; and L_o represents original length of material.

Preferably the elastomeric net layer of the composites of the invention has a recovery of at least about 90 percent or greater when stretched to 100% elongation, i.e., $L_s = 2L_o$, and more preferably a recovery of about 95% or greater when stretched to 100% elongation. In addition it is preferred that elastomeric nets used in composites of the invention have a low stress relaxation at 100 °F of less than 30 % decrease in stress, preferably less than 20% decrease in stress, when held at 100 % elongation for 5 minutes. It is also preferred that the elastomeric net exhibit less than 25 % creep, preferably less than 20 % creep, i.e., increase in elongation, at 100 °F when held under a load of 200 g/in. for five minutes.

Figure 1 illustrates in perspective view an elastomeric net 10, shown in roll form, which can be used in producing fabrics of the invention. The elastomeric net 10 includes an elastic material making up the strands 12 of the net including the longitudinal, i.e. machine direction, strands and the transverse, i.e. cross machine direction, strands, (assuming the net is rectangular). The elastic net 10 can be prepared by any of various well known processes including the process disclosed in U.S. Patent 4,636,419, issued January 13, 1987 to Madsen, et al., incorporated herein by reference. In general, the elastic net is made by extruding a plurality of substantially elastomeric strands in the machine direction while simultaneously or thereafter extruding and joining to the machine direction strands, a plurality of elastomeric polymeric strands oriented substantially in the cross machine direction. Although it is preferred that strands of the net intersect to form substantially regular, rectangular shaped openings, it will be apparent that the net can also have a non-rectangular geometry, e.g., having strands oriented to form diamond shaped openings or the like.

The elastomeric material making up the strands 12 of the net normally comprise at least one thermoplastic elastomer. Suitable thermoplastic elastomers include the diblock, triblock, radial and star copolymers based on polystyrene (S) and unsaturated or fully hydrogenated rubber blocks. The rubber block can consist of butadiene (B), isoprene (I), or the hydrogenated version, ethylene-butylene (EB). For example, S-B, S-I, S-EB, as well as S-B-S, S-I-S, S-EB-S linear block copolymers can be used. Typically when used one or more of the diblock copolymers are blended with the triblock or radial copolymer elastomers. Preferred thermoplastic elastomers of this type can include the KRATON polymers

sold by Shell Chemical Company or the VECTOR polymers sold by DEXCO. Other elastomeric thermoplastic polymers include polyurethane elastomeric materials such as ESTANE sold by BF Goodrich Company; polyester elastomers such as HYTREL sold by E. I. Du Pont De Nemours Company; polyetherester elastomeric materials such as ARNITEL sold by Akzo Plastics; and polyetheramide elastomeric materials such as PEBAX sold by ATO Chemie Company; and the like.

The elastomeric strands of the elastomeric net 10 can also be prepared from blends of thermoplastic elastomers with other polymers such as polyolefin polymers, e.g. blends of Kraton polymers with polyolefins such as polypropylene and polyethylene, and the like. These polymers can provide lubrication and decrease the melt viscosity, allow for lower melt pressures and temperatures and/or increase throughput, and provide better bonding properties too. In a preferred embodiment of the invention, such other polymers can be included in the blend as a minor component, for example in an amount of between about 5% by weight up to 50% by weight, preferably from about 10 to about 30% by weight of the mixture. Suitable thermoplastic polymers, include, in addition to the polyolefin polymers, poly(ethylene-vinyl acetate) polymers having an ethylene content of up to about 50% by weight, preferably between 15 and 30% by weight and copolymers of ethylene and acrylic acid or esters thereof, such as poly(ethylene-methyl acrylate) or poly(ethylene-ethyl acrylate) wherein the acrylate acid or ester component ranges from about 5 to about 50% by weight, preferably from about 15 to about 30% by weight. In addition polystyrene and poly(alpha-methyl styrene) can be used.

In one preferred embodiment of the invention, the strands can comprise an adherence promoting additive to improve the adherence of the machine

direction strands to the cross-machine direction strands. Preferred additives to improve adherence include poly(ethylene-vinyl acetate) polymers having an ethylene content of up to about 50% by weight, preferably between about 15 and about 30% by weight, and copolymers of ethylene and acrylic acid or esters thereof, such as poly(ethylene-methyl acrylate) or poly(ethyl acrylate) wherein the acrylic acid or ester component ranges from about 5 to about 50% by weight, preferably from about 15 to 30% by weight. These materials are preferably included in strands in an amount of between about 2 and about 50% by weight, preferably between about 10 and about 30% by weight depending on the primary component of the strand. In addition other materials such as plasticizers, tackifiers, talc, and the like can be compounded into the resin at low levels to promote bonding.

The degree of elasticity of the longitudinal and transverse strands 12 of a rectangular elastomeric net can be the same or different. Fabrics having differential stretch in the longitudinal and transverse directions can be provided in accordance with the invention by employing strands 12 in the elastomeric net in either the transverse or longitudinal direction which have only little elasticity.

In many instances, it is desirable that the number of strands per inch in the longitudinal and transverse dimensions be different. Generally, there are between about 2 to about 30 strands per inch in both the longitudinal and transverse directions although greater numbers of strands can be employed where desirable. In some instances, the fabric of the invention can be used in articles wherein an edge of the fabric is exposed. In such instances it can be desirable to minimize the diameter of the strands which will be exposed along the cut edge of the fabric. Generally, the elastomeric nets used in the invention

will have a basis weight ranging from about 15 grams per square meter, to about 200 grams per square meter, more preferably from about 75 to about 100 grams per square meter and can employ strands having diameters ranging from 50 to 600 microns.

Figure 2 schematically illustrates one preferred method and apparatus for manufacturing one preferred composite elastic nonwoven web from the combination of meltblown elastomeric layers and an elastomeric net according to the invention. A conventional meltblowing apparatus 14 forms a meltblown elastomeric fibrous stream 16 which is deposited onto a forming screen 18. Meltblowing processes and apparatus are known to the skilled artisan and are disclosed, for example, in U.S. Patent 3,849,241 to Buntin, et al. and U.S. 4,048,364 to Harding, et al.

The meltblowing process involves extruding a molten thermoplastic elastomer 20 (which can be formed of the elastomers described above in regard to the elastomeric net 10), through fine capillaries 22 into fine filamentary streams. The filamentary streams exit the meltblowing spinneret head where they encounter converging streams of high velocity heated gas 24, typically air, supplied from a pair of converging nozzles. The converging streams of high velocity heated gas attenuate the polymer streams and break the attenuated streams into meltblown fibers.

An elastomeric meltblown web 20 is thus formed on, and conveyed by forming screen to the next station at which a conventional supply system applies the elastomeric net 10 onto the moving meltblown web 20. As discussed previously, the elastomeric net 10 includes spaced apart machine direction and cross machine direction strands which intersect to form apertures. A roll 26 applies tension to the two-layered structure 28 which is formed from the combination of the meltblown web and the net layer 10.

The two layer structure is advanced in the machine direction by forming screen 18.

A second meltblowing apparatus 30, constructed the same as meltblowing apparatus 14, deposits a second elastomeric meltblown fibrous layer 34 onto the composite structure 28. The elastomeric meltblown layer 34 entangles with and/or bonds to the previously formed composite structure 28 to thereby form a composite elastic fabric 36. This fabric is conveyed by a conveying roll 38 for wind-up and storage as a roll 38. The fabric 36 stored on roll 38 may be immediately or later passed to end use manufacturing processes, for example, for use in bandages, diapers, disposable undergarments, personal hygiene products, industrial products and the like.

The composite elastic fabric formed by the process of Figure 2 is illustrated in Figure 3. As shown, the composite fabric is a unitary structure including meltblown elastomeric fibers 38 and elastomeric strands 12 from net 10 within an interior portion of the composite fabric 36. As a result of the direct formation of meltblown layer 34 onto net 10, at least a portion of the meltblown fibers 38 extend through apertures in the elastomeric net and/or are bonded to strands 12 of the net. Preferably, the meltblowing apparatus 30 which forms a meltblown layer on net 10 is sufficiently closely spaced to the forming wire 18 and operated at a force sufficient to force at least a portion of the meltblown fibers into and/or through the apertures in the elastomeric net 20.

The method illustrated in Figure 2 is susceptible to numerous preferred variations. For example, although the schematic illustration of Figure 1 shows meltblown webs being formed directly during the in-line process, it will be apparent that one or both of the webs can be preformed and supplied as rolls of preformed webs, although this is not preferred. In

such an instance thermal bonding from heated calanders or the like, or adhesive bonding, can be used to unite the layers into a unitary structure. Similarly, although the elastomeric net is shown being supplied as a roll of a preformed net, the net can be formed directly in-line.

Similarly, although Figure 2 illustrates use of fibrous elastomeric meltblown webs 20 and 34 both above and below the elastomeric net 20, only a single meltblown web such as web 34 can be employed or more than two meltblown webs can be employed. Additionally, in another preferred embodiment of the process shown in Figure 2, both meltblown webs can be formed directly onto net 10 by forming a first meltblown layer onto the net to form an intermediate composite structure, and then turning over the composite to expose the net side and forming the second meltblown layer thereon.

Figure 4 schematically illustrates one preferred method and apparatus for manufacturing another preferred composite elastic nonwoven fabric of the invention from the combination of spunbond elastomeric layers and an elastomeric net. The spunbond elastomeric layers employed in this embodiment of the invention are preferably formed in accordance with the teachings of U.S. Patent Application Serial No. 07/829,923 of Gessner, et al.; filed February 3, 1992; and entitled "Elastic Nonwoven Webs and Method of Making Same", which is hereby incorporated in its entirety into this application by reference.

Elastomeric spunbond layers are preferably produced by melt spinning substantially continuous filaments of a thermoplastic olefin-based elastomer. These olefinic elastomers are formed using metallocene polymerization catalysis and are commercially available as the EXACT resins from Exxon, which are linear low-density polyethylenes, and the CATALLOY resins from Himont, which are crystalline olefin, heterophasic

copolymers including a crystalline base polymer fraction, i.e., block, and an amorphous copolymer fraction or block with elastic properties as a second phase blocked to the crystalline base polymer fraction via a semi-crystalline polymer fraction.

These elastomeric spunbonded fabrics have a desirable soft hand and elastomeric properties such that the spunbonds exhibit a root mean square (RMS) recoverable elongation of at least about 75% in both the machine direction (MD) and the cross direction (CD) after 30% elongation and one pull. Preferably the spunbond fabrics are prepared by conducting a slot draw spunbonding process at a rate of less than 2000 meters per minute, e.g., less than 1500 m/min. employing an elastomeric thermoplastic resin as feed.

Returning to Figure 4, a spunbond apparatus is shown at 50 and is preferably a slot drawing apparatus as known in the art. Slot drawing apparatus 50 includes a melt spinning section including a feed hopper 52 and an extruder 53 for the polymer. The extruder 53 is provided with a generally linear die head or spinneret 54 for melt spinning streams of substantially continuous filaments 55. The substantially continuous filaments 55 are extruded from the spinneret 54 and typically are quenched by a supply of cooling air (not shown). The filaments are directed to an attenuation slot 56 which includes downwardly moving attenuation air which can be supplied from forced air above the slot, vacuum below the slot, or eductively within the slot, as known in the art. The attenuation slot may be separate from or integral with the drawing slot as also known in the art. The air and filaments exit the attenuation slot 56 and are collected on a forming wire 58 as a nonwoven spunbond web 60.

Advantageously, the filaments 55 are extruded from the spinneret 54 at a rate sufficient to provide

drawn filaments at a spinning rate of about 100 to about 2000 meters per minute. The forming wire 58 is typically moved at a slower linear velocity than the spinning rate (linear velocity of the filaments) to increase the density and cover of the spunbond web 60. In a preferred embodiment, the filaments 55 are produced at a rate of about 450 to about 1200 meters per minute. Drawing forces sufficient to provide a spinning rate in excess of 1200-2000 meters per minute are advantageously avoided because excess filament breakage can occur due to the elastic nature of polymer. Preferably the filaments of the spunbond web 60 have a denier per filament in the range less than about 50 denier per filament, more preferably from about 1 to about 10 denier per filament, and most preferably from about 2 to about 6 denier per filament.

Preferred polymers for forming elastomeric spunbond layers used in the composites of the invention are the EXACT elastomeric linear low density polymers (Exxon). These polymers come in multiple grades. Spunbond fabrics made from these polymers all have good extensibility. One big change in spunbond fabric properties with changing resin grades is the degree of recovery of the fabric. The higher density materials have less recovery. The lower density materials have good recovery, albeit not as good as some commercially available elastic nets. Properties of the Exxon EXACT polymers are shown below in Table 1.

TABLE 1. PROPERTIES OF POLYMERS.

	RESIN GRADE (Manufacturer's Designation)					
PROPERTY	2004	2003	3017	4014	5004	5009
Density, g/cm³	0.93	0.92	0.90	0.89	0.87	0.87
T_m°C	115.6	107.7	87.5	73.3	47.5	44.5
T_C°C	101.6	96.5	76.3	52.7	30.7	25.5
M.I. (dg/min)	28.7	31	25	31	19	18.2
GPC M_N	14.6	21.4	17.2	21.7	21.8	24.2
GPC M_W	44.4	45.5	43.2	45.2	47.8	51.7
MWD M_W/M_N	3.00	2.10	2.50	2.10	2.20	2.10

Spunbond fabrics spun from the above polymers also have differences in hand. The lowest density materials have a distinctly unfavorable rubbery hand. These materials are tacky and feel clammy to the skin. The medium density materials have a very soft, good feeling hand.

The presently preferred elastic spunbond fabric for use in the composites of the invention is made from EXACT 3017. The base spunbond material has the following mechanical properties, in a five cycle 100% elongation hysteresis test (machine direction only):

100% Elongation Test

Cycle One Tensile, g/in: 640
Cycle Five Tensile, g/in: 551
Permanent Set: 42%
Basis Weight, g/m²: 60
Elongation at Peak: 182%

40% Elongation Test

Cycle One Tensile, g/in: 373
Cycle One Tensile, g/in: 302
Permanent Set: 18%
Basis Weight, g/m²: 60
Elongation at Peak: 182%

As indicated previously, thermoplastic primarily crystalline olefin block copolymers having elastic properties are also advantageously used to form spunbonds. These polymers are commercially available

from Himont, Inc., Wilmington, Delaware, and are disclosed in European Patent Application Publication 0416379 published March 13, 1991, which is hereby incorporated by reference. The polymer is a heterophasic block copolymer including a crystalline base polymer fraction and an amorphous copolymer fraction having elastic properties which is blocked thereon via a semi-crystalline homo- or copolymer fraction. In a preferred embodiment, the thermoplastic primarily crystalline olefin polymer is comprised of at least about 60 to 85 parts of the crystalline polymer fraction, at least about 1 up to less than 15 parts of the semi-crystalline polymer fraction and at least about 10 to less than 39 parts of the amorphous polymer fraction. Advantageously, the primarily crystalline olefin block copolymer comprises 65 to 75 parts of the crystalline copolymer fraction, from 3 to less than 15 parts of the semi-crystalline polymer fraction, and from 10 to less than 30 parts of the amorphous copolymer fraction.

Preferably the crystalline base polymer block of the heterophasic copolymer is a copolymer of propylene and at least one alpha-olefin having the formula $H_2C{=}CHR$, where R is H or a C_{2-6} straight or branched chain alkyl moiety. Preferably, the amorphous copolymer block with elastic properties of the heterophasic copolymer comprises an alpha-olefin and propylene with or without a diene or a different alpha-olefin termonomer, and the semi-crystalline copolymer block is a low density, essentially linear copolymer consisting substantially of units of the alpha-olefin used to prepare the amorphous block or the alpha-olefin used to prepare the amorphous block present in the greatest amount when two alpha-olefins are used.

Other elastomeric polymers which can be used to form elastomeric spunbonds include polyurethane

elastomers; ethylene-polybutylene copolymers; poly(ethylene-butylene) polystyrene block copolymers, such as those sold under the trade names Kraton G-1657 and Kraton G-1652 by Shell Chemical Company, Houston, Texas; polyadipate esters, such as those sold under the trade names Pellethane 2355-95 AE and Pellethane 2355-55DE by Dow Chemical Company, Midland, Michigan; polyester elastomeric polymers; polyamide elastomeric polymers; polyetherester elastomeric polymers, such as those sold under the trade name Hydrel by DuPont Company of Wilmington, Delaware; ABA triblock or radial block copolymers, such as Styrene-Butadiene-Styrene block copolymers sold under the trade name Kraton by Shell Chemical Company; and the like. Also, polymer blends of elastomeric polymers, such as those listed above, with one another and with other thermoplastic polymers, such as polyethylene, polypropylene, polyester, nylon, and the like, may also be used in the invention. Those skilled in the art will recognize that elastomer properties can be adjusted by polymer chemistry and/or by blending elastomers with non-elastomeric polymers to provide elastic properties ranging from fully elastic stretch and recovery properties to relatively low stretch and recovery properties. Preferably a low to medium elastic property elastomer is used in the spunbond process as evidenced by a flexural modulus ranging from about 200 psi to about 10,000 psi, and preferably from about 2000 psi to about 8000 psi.

The thermoplastic spunbond webs are formed from a resin including the thermoplastic elastomer in an amount sufficient to give the fabric at least about a 75% root mean square (RMS) average recoverable elongation based on machine direction (MD) and cross direction (CD) values after 30% elongation and one pull. RMS average recoverable elongations are calculated from the formula: RMS average recoverable

elongation = $[\frac{1}{2}(CD^2 + MD^2)]^{1/2}$; wherein CD is recoverable elongation in the cross direction and MD is the recoverable elongation in the machine direction. Preferably, the fabrics have at least about a 70% RMS recoverable elongation after two such 30% pulls. More preferably, the fabrics comprise the thermoplastic elastomer in an amount sufficient to give the fabric at least about a 65% RMS recoverable elongation based on machine direction and cross direction values after 50% elongation and one pull, and even more preferably at least about 60% RMS recoverable elongation after two such pulls. Preferably the elastomer constitutes at least about 50%, most preferably at least about 75%, by weight of the filament. Elastic properties of fabrics of the invention are measured using an Instron Testing apparatus, using a 5 inch gauge length and a stretching rate of 5 inches per minute. At the designated stretch or percent elongation value, the sample is held in the stretched state for 30 seconds. The elongation of the sample is then decreased at the same rate of 5 in./min. until the original 5 inch gauge length is obtained. The percent recovery can then be measured.

Returning now to Figure 4, the elastomeric spunbond fabric 60 is thus formed on, and conveyed by forming screen 58 to the next station at which a conventional supply system applies the elastomeric net 10 onto the moving spunbond web 20. A roll 62 applies tension to the two-layered structure 64 which is formed from the combination of the spunbond web and the net layer 10. The two layer structure is advanced in the machine direction by forming screen 58.

A second spunbond apparatus 66, constructed the same as spunbond apparatus 50, forms a curtain of filaments 68 which are deposited as a second elastomeric spunbond fibrous layer 69 onto the composite structure 64. The three layered structure 70 is then conveyed to a pair of heated calender rolls 72

and 74. The operating temperature of heated rolls 72 and 74 should be adjusted to a surface temperature such that the spunbond fibers are heated sufficiently to soften the fibers and to bond the composite web into a unitary structure. On the other hand, the heat transfer conditions are advantageously maintained to avoid thermal degradation or melting of the elastomeric net 10 which is present within the interior of the composite web 70. The bonding conditions can, in some instances depending on the fibers and net used, be controlled to obtain fiber bonding to the net, while simultaneously avoiding thermal degradation of the elastomer or its stretch and recovery properties.

While softening of the elastomeric net 10 can, in some instances, be desirable and helpful for bonding of the spunbond fibers in the composite web to the net, melting of the elastomeric net is advantageously avoided. In advantageous embodiments of the invention, avoidance of melting of the net is achieved in part by selecting an elastomer resin for forming the spunbond that has a melting point of at least 5 °C, preferably at least 10 °C, less than the melting point of the net. This allows use of low temperature, high pressure calender conditions for bonding of the composite without melting of strands of the net.

A thermally-bonded composite elastic fabric 76 is removed from the nip of the heated rolls 72 and 74 and wound by conventional means onto roll 80. The composite elastic fabric 78 can be stored on roll 80 or immediately passed to end use manufacturing processes, for example for use in bandages, diapers, disposable undergarments, personal hygiene products and the like. Blocking of the layers of the composite on the roll can be avoided in accordance with the invention by employing resins having a very narrow molecular weight distribution for forming the spunbond, such as the

linear low density polyethylene elastomer resins commercially available from Exxon discussed previously. Narrow molecular weight distribution minimizes the presence of very low molecular weight polymer fragments which can act like plasticizers and/or adhesives and cause blocking of adjacent layers on a roll.

The composite elastic fabric formed by the process of Figure 4 is illustrated in Figure 5. As shown, the composite fabric is a unitary structure including spunbond layers 69 and 69 having elastomeric strands 12 from net 10 sandwiched between the two layers. The three layer structure is joined into a unitary product by thermal spot bonds 82 which may be formed on one or both sides of the composite fabric. The thermal bonds can be formed between only the two spunbond layers or between one or both of the spunbond layers and strands 12 of net 10.

The method illustrated in Figure 2 is susceptible to numerous preferred variations. For example, although the schematic illustration of Figure 4 shows spunbond webs being formed directly during the in-line process, it will be apparent that one or both of the webs can be preformed, lightly bonded fabrics, and supplied as rolls of preformed fabrics. Similarly, although the elastomeric net is shown being supplied as a roll of a preformed net, the net can be formed directly in-line. Although Figure 4 illustrates use of two fibrous spunbond webs, one above and one below the elastomeric net 10, only a single spunbond web can be employed or more than two spunbond webs can be employed.

In addition, the spunbond web or webs may be bonded or joined to the elastomeric net in any of the ways known in the art. Lamination and/or bonding may be achieved, for example, various spot bonding techniques, by ultrasonic bonding or powder bonding. It is also possible to achieve bonding through the use

of an appropriate bonding agent, i.e., an adhesive. The term spot bonding is inclusive of continuous or discontinuous pattern bonding, uniform or random point bonding or a combination thereof, all as are well known in the art.

As will be apparent from the foregoing although the elastomeric nonwoven composite fabrics of the invention are advantageously formed entirely from elastomeric layers, the fabric can be laminated or otherwise joined to other layers, fabrics and materials for the formation of various useful articles, such as diapers, disposable undergarments and the like. In addition, the composite elastic nonwoven fabrics of the invention are also formed from the combination of elastomeric nets with fibrous elastomeric layers other than meltblown or spunbond webs, in accordance with the invention. Such elastomeric fibrous webs include nonwoven webs formed from staple fibers and/or yarns and which have been coated or impregnated with an elastomeric material and consolidated into a web by adhesive and thermal bonding. The composite elastic fabrics of the invention provide improved elastic properties as compared to numerous prior art fabrics and avoid manufacturing complexities associated with many prior art fabrics.

The following examples are provided to illustrate the fabrics of the invention and processes for making them but are not to be construed as limitations on the invention.

EXAMPLE 1

An elastic meltblown web was made from the following elastomers:

- 60% Kraton G 1657 (Shell Chemical)
- 40% Optema TC-140 (Exxon Chemical)

The Kraton G 1657 is a styrene-(ethylene-butylene)-styrene block copolymer.

The Optema TC-140 is a ethylene-methyl acrylate random copolymer. This 60/40 blend was meltblown onto an elastic net. The elastic net consisted of styrene-isoprene-styrene block copolymer mixed with a styrene-butadiene-styrene block copolymer. These materials are known by the trade names Kraton D (marketed by Shell Chemical) or Vector (marketed by DEXCO, a Dow-Exxon Partnership).

The elastic meltblown fibers were meltblown directly onto the elastic net to form a meltblown-net composite. Another meltblown web was then formed on the composite; this time on the other side of the net. The result was an elastic trilaminate construct with the following basis weights:

Side 1: Elastic Meltblown Fibers, 40 g/m^2
Side 2: Elastic Net, 110 g/m^2
Side 3: Elastic Meltblown Fibers, 40 g/m^2

This resulting composite fabric had some very unique properties, and in particular would be very useful for filtration or controlled porosity applications. Both the net and meltblown layers are highly extensible. Under low extension, the material has relatively low air permeability. As extension increases, air permeability in turn increases. Thus, porosity and air permeability can be controlled by simply stretching or relaxing the elastic composite exactly as desired.

EXAMPLE 2

An elastic composite was made in the same manner as Example 1, with the following exception: the elastic meltblown web was formed on one side of the net only. This material was much like that of Example 1, in that porosity could be readily controlled via elongation of the material. However, this material was clearly two-sided, with a relatively bumpy net on one side and a smooth meltblown layer on the other side.

THAT WHICH IS CLAIMED IS:

1. A composite elastic nonwoven fabric formed from the combination of a plurality of cooperative elastic layers comprising:

an elastomeric fibrous layer; and

an elastomeric net layer having different elastic properties as compared to said fibrous elastomeric layer;

said plurality of elastomeric layers being joined together in a unitary elastic fabric structure to provide a composite having a combination of different elastic properties.

2. The nonwoven fabric of Claim 1 wherein said elastomeric fibrous web comprises a meltblown web.

3. The nonwoven fabric of Claim 1 wherein said elastomeric fibrous web comprises an elastomeric spunbond web.

4. The nonwoven fabric of Claim 1 wherein said elastomeric net has lower creep and stress relaxation properties than said elastomeric fibrous layer.

5. The nonwoven fabric of Claim 4 wherein said elastomeric net comprises strands oriented to provide substantially rectangular openings.

6. The nonwoven fabric of Claim 4 wherein said elastomeric net comprises strands oriented to provide substantially non-rectangular openings.

7. The nonwoven fabric of Claim 4 wherein said elastomeric net comprises a thermoplastic elastomer.

8. The nonwoven fabric of Claim 7 wherein said elastomer is crosslinked.

9. The nonwoven fabric of Claim 4 wherein said elastomeric net comprises an A-B-A block copolymer, wherein A represents a styrene block and B represents unsaturated or fully hydrogenated rubber block.

10. The nonwoven fabric of Claim 4 wherein said elastomeric net comprises a blended thermoplastic polymer.

11. The nonwoven fabric of Claim 4 wherein said elastomeric net comprises between about 2 and about 30 strands per inch in each direction.

12. A composite elastic nonwoven fabric formed from the combination of a plurality of cooperative elastic layers comprising:

an elastomeric meltblown web; and

an elastomeric net;

said elastomeric meltblown web and said elastomeric net being joined together in a unitary elastic fabric structure to provide a composite having a combination of different elastic properties.

13. The nonwoven fabric of Claim 12 wherein said meltblown web has been formed directly on said elastomeric net so that the meltblown fibers are bonded to themselves and to the elastomeric net.

14. The nonwoven fabric of Claim 12 additionally comprising a second meltblown web, said elastomeric net being sandwiched between said meltblown webs.

15. The nonwoven fabric of Claim 12 wherein said elastomeric net has lower creep and stress relaxation properties than said elastomeric meltblown web.

16. The nonwoven fabric of Claim 15 wherein said elastomeric net comprises strands oriented to provide substantially rectangular openings.

17. The nonwoven fabric of Claim 15 wherein said elastomeric net comprises a thermoplastic elastomer.

18. The nonwoven fabric of Claim 17 wherein said elastomer is crosslinked.

19. The nonwoven fabric of Claim 15 wherein said elastomeric net comprises an A-B-A block copolymer, wherein A represents a styrene block and B represents unsaturated or fully hydrogenated rubber block.

20. The nonwoven fabric of Claim 15 wherein said elastomeric net comprises a blended thermoplastic polymer.

21. The nonwoven fabric of Claim 15 wherein said elastomeric net comprises between about 2 and about 30 strands per inch in each direction.

22. The nonwoven fabric of Claim 21 wherein said meltblown web comprises an A-B-A block copolymer, wherein A represents a styrene block and B represents unsaturated or fully hydrogenated rubber block.

23. The nonwoven fabric of Claim 22 wherein said meltblown web comprises a blended thermoplastic polymer.

24. A composite elastic nonwoven fabric formed from the combination of a plurality of cooperative elastic layers comprising:

an elastomeric spunbond fabric; and

an elastomeric net;

said elastomeric spunbond fabric and said elastomeric net being joined together in a unitary elastic fabric structure to provide a composite having a combination of different elastic properties.

25. The nonwoven fabric of Claim 24 wherein said spunbond fabric comprises an elastomeric linear low density polyethylene polymer.

26. The nonwoven fabric of Claim 24 additionally comprising a second elastomeric spunbond web, said elastomeric net being sandwiched between said spunbond webs.

27. The nonwoven fabric of Claim 26 wherein said elastomeric net has lower creep and stress relaxation properties than said elastomeric spunbond web.

28. The nonwoven fabric of Claim 27 wherein said elastomeric net and said spunbond webs are joined together by thermal bonding.

29. The nonwoven fabric of Claim 27 wherein said elastomeric net and said spunbond webs are joined together by spotbonds.

30. The nonwoven fabric of Claim 29 wherein said spunbond webs have a melting point at least 5°C lower than the melting point of said elastomeric net.

31. The nonwoven fabric of Claim 28 wherein said elastomeric net comprises an A-B-A block copolymer, wherein A represents a styrene block and B represents unsaturated or fully hydrogenated rubber block.

32. The nonwoven fabric of Claim 28 wherein said elastomeric net comprises a blended thermoplastic polymer.

33. The nonwoven fabric of Claim 28 wherein said elastomeric net comprises between about 2 and about 30 strands per inch in each direction.

34. The nonwoven fabric of Claim 28 wherein said spunbond web comprises a crystalline olefin, heterophasic copolymer including a crystalline base polymer block, and an amorphous copolymer block with elastic properties as a second phase blocked to the crystalline base polymer block via a semi-crystalline polymer block.

35. The nonwoven fabric of Claim 28 wherein said meltblown web comprises a blended thermoplastic polymer.

36. The process for producing a composite elastic nonwoven fabric having a combination of different elastic properties comprising the steps:

preparing a plurality of elastomeric nonwoven layers comprising an elastomeric fibrous layer and

an elastomeric net layer having different elastic properties as compared to said elastomeric fibrous layer; and

joining said plurality of nonwoven elastomeric layers cooperatively together into a unitary composite nonwoven elastic fabric having a combination of the different elastic properties of said elastomeric nonwoven layers.

37. The process of Claim 36 wherein said first elastomeric fibrous web comprises a meltblown web.

38. The process of Claim 36 wherein said first elastomeric fibrous web comprises an elastomeric spunbond web.

39. The process of Claim 36 wherein said joining step is accomplished by adhesive or thermal bonding.

40. The process of Claim 39 wherein said elastomeric net has lower creep and stress relaxation properties than said elastomeric spunbond web.

41. The process of Claim 39 wherein said elastomeric net comprises strands oriented to form rectangular openings.

42. The process of Claim 39 wherein said elastomeric net comprises a thermoplastic elastomer.

43. The process of Claim 39 wherein said elastomeric net comprises an A-B-A block copolymer, wherein A represents a styrene block and B represents unsaturated or fully hydrogenated rubber block.

44. The process of Claim 39 wherein said joining step is conducted while maintaining said plurality of elastomeric layers in a substantially unstretched state.

45. The process for producing a composite elastic nonwoven fabric having a combination of different elastic properties comprising the steps:

preparing a plurality of elastomeric nonwoven layers comprising an elastomeric meltblown web and an elastomeric net; and

thermally or adhesively joining said elastomeric meltblown web and said elastomeric net cooperatively together into a unitary composite nonwoven elastic fabric having a combination of the different elastic properties of said elastomeric meltblown web and said elastomeric net.

46. The process of Claim 45 wherein said preparing and joining steps comprise forming said elastomeric meltblown web directly on said elastomeric net so that the meltblown fibers of said elastomeric meltblown web are bonded to themselves and to the elastomeric net.

47. The process of Claim 45 wherein said plurality of elastomeric layers additionally comprises a second meltblown web, and wherein said plurality of layers are joined together such that said elastomeric net is sandwiched between and contained within said meltblown webs.

48. The process of Claim 45 wherein said elastomeric net has lower creep and stress relaxation properties than said elastomeric spunbond web.

49. The process of Claim 45 wherein said elastomeric net comprises strands oriented to form rectangular openings.

50. The process of Claim 45 wherein said elastomeric net comprises a thermoplastic elastomer.

51. The process of Claim 50 wherein said elastomeric net comprises an A-B-A block copolymer, wherein A represents a styrene block and B represents unsaturated or fully hydrogenated rubber block.

52. The process of Claim 50 wherein said elastomeric net comprises between about 2 and about 30 strands per inch in each direction.

53. The process of Claim 45 wherein said meltblown web comprises an A-B-A block copolymer, wherein A represents a styrene block and B represents unsaturated or fully hydrogenated rubber block.

54. The process of Claim 53 wherein said meltblown web comprises a blended thermoplastic polymer.

55. The process for producing a composite elastic nonwoven fabric having a combination of different elastic properties comprising the steps:

preparing a plurality of elastomeric nonwoven layers comprising an elastomeric spunbond fabric and an elastomeric net; and

thermally or adhesively bonding said elastomeric spunbond fabric and said elastomeric net cooperatively together into a unitary composite nonwoven elastic fabric having a combination of the different elastic properties of said elastomeric spunbond fabric and said elastomeric net.

56. The process of Claim 55 wherein said bonding step is conducted while maintaining said elastomeric spunbond fabric and said elastomeric net in a substantially unstretched state.

57. The process of Claim 56 wherein said spunbond fabric comprises an elastomeric linear low density polyethylene polymer.

58. The process of Claim 55 wherein said plurality of elastomeric layers additionally comprises a second elastomeric spunbond fabric, and wherein said plurality of layers are bonded together such that said elastomeric net is sandwiched between said spunbond fabrics.

59. The process of Claim 55 wherein said elastomeric net has lower creep and stress relaxation properties than said elastomeric spunbond web.

60. The process of Claim 59 wherein said elastomeric net and said spunbond webs are joined together by thermal bonding.

61. The process of Claim 60 wherein said elastomeric net and said spunbond webs are joined together by spotbonds.

62. The process of Claim 61 wherein said spunbond webs have a melting point at least 5°C lower than the melting point of said elastomeric net.

63. The process of Claim 61 wherein said elastomeric net comprises a thermoplastic elastomer.

64. The process of Claim 63 wherein said elastomeric net comprises an A-B-A block copolymer, wherein A represents a styrene block and B represents unsaturated or fully hydrogenated rubber block.

65. The process of Claim 64 wherein said elastomeric net comprises a blended thermoplastic polymer.

66. The process of Claim 61 wherein said elastomeric net comprises between about 2 and about 30 strands per inch in each direction.

67. The process of Claim 61 wherein said spunbond web comprises a crystalline olefin, heterophasic copolymer including a crystalline base polymer block, and an amorphous copolymer block with elastic properties as a second phase blocked to the crystalline base polymer block via a semi-crystalline polymer block.

68. The process of Claim 57 wherein said plurality of elastomeric layers additionally comprises a second elastomeric spunbond web, and wherein said plurality of layers are joined together such that said elastomeric net is sandwiched between said spunbond webs.

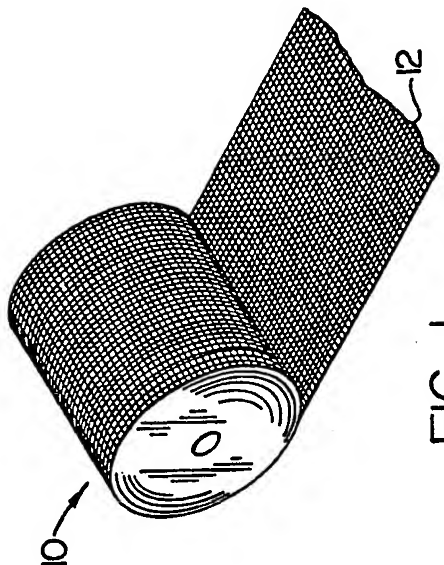

FIG. 1.

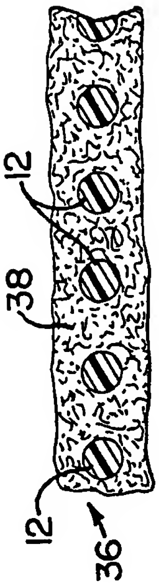

FIG. 3.

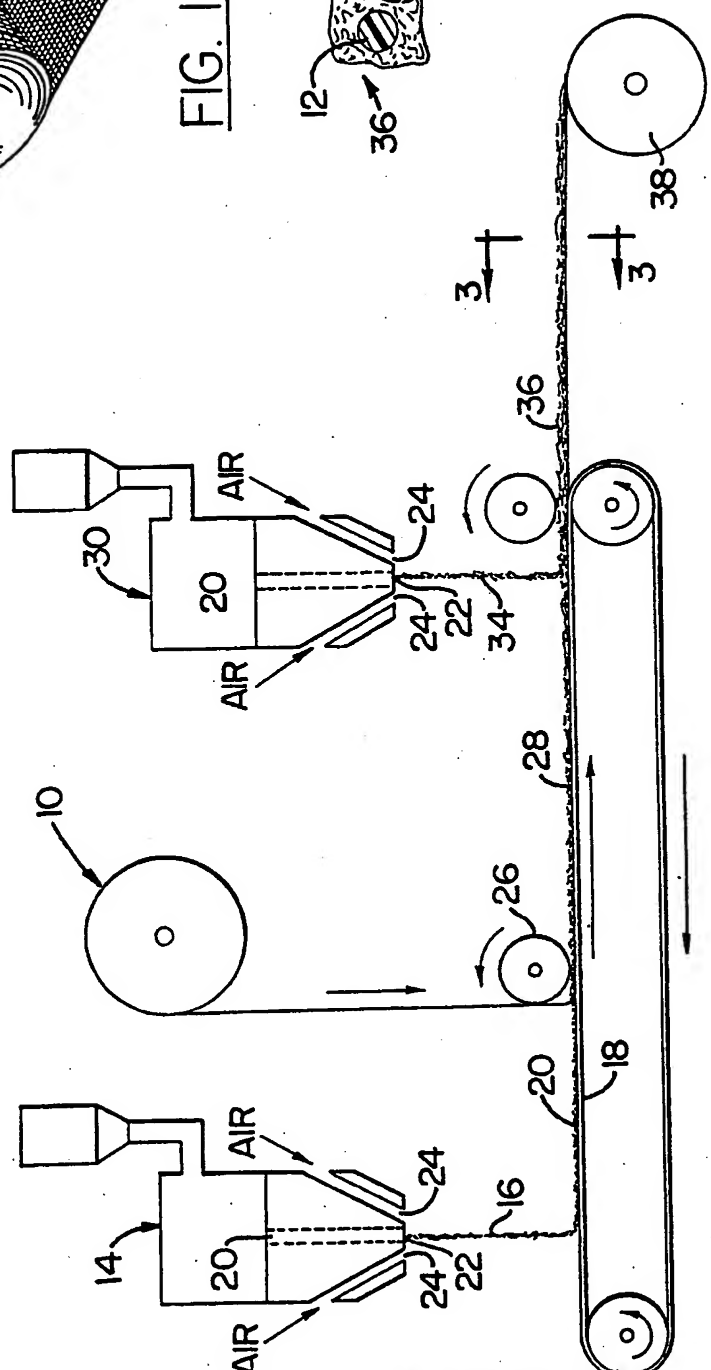

FIG. 2.

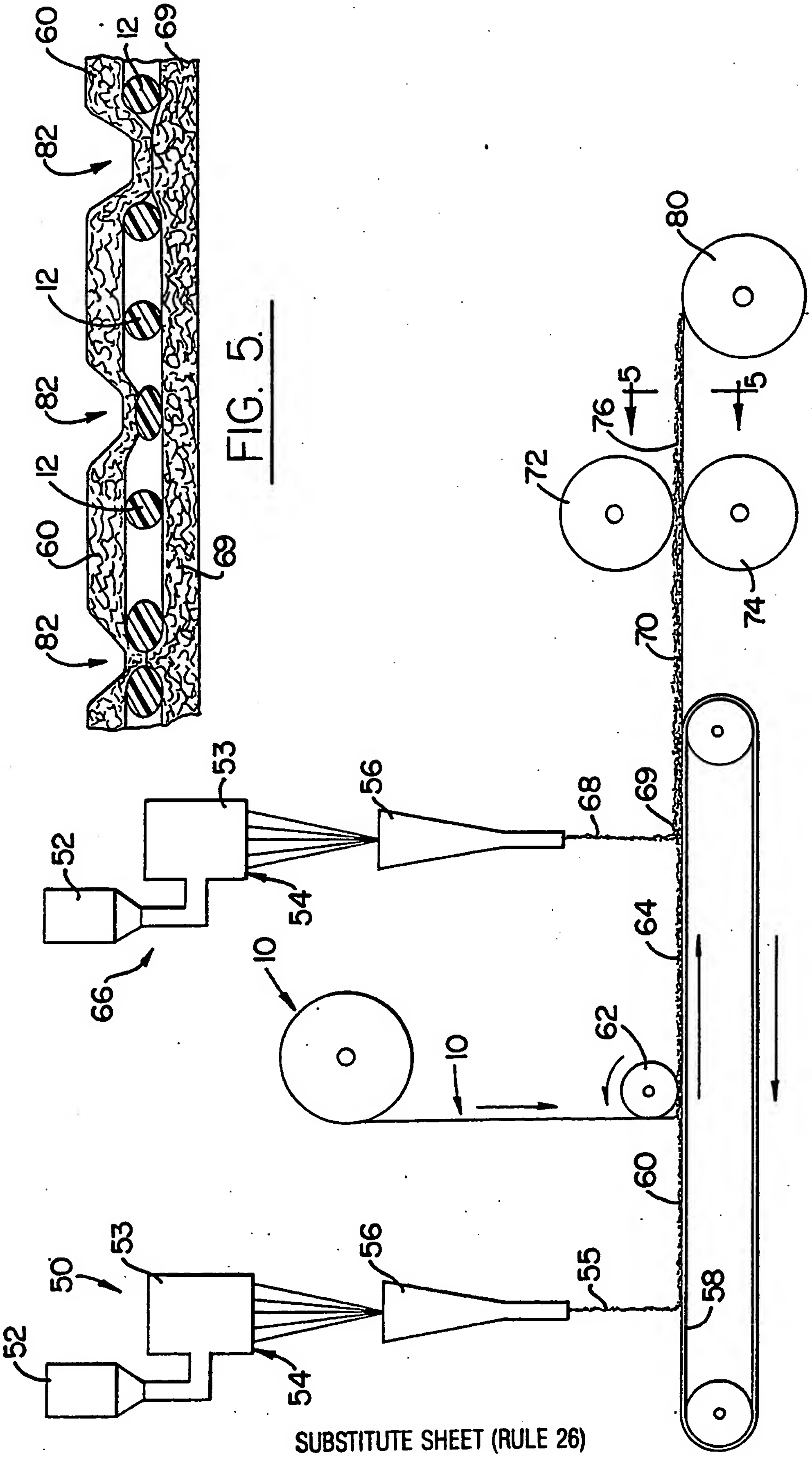
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FIG. 5.

FIG. 4.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 93/06747

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 D04H13/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 D04H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
E	WO,A,93 15247 (FIBERWEB NORTH AMERICA INC.) 5 August 1993 see page 4, line 31 - page 19, line 6 ---	1-3,5-7, 9-14, 24-26, 28,36, 37,39, 41-47, 49-52
A	EP,A,0 007 802 (TEIJIN LTD.) 6 February 1980 see page 3, line 28 - page 18, line 37 -----	1,5-7, 12,14

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed
- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

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Date of the actual completion of the international search	Date of mailing of the international search report
5 April 1994	15.04.94

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	V Beurden-Hopkins, S

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/US 93/06747

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
WO-A-9315247	05-08-93	AU-B-	3482093	01-09-93
		AU-B-	3589193	01-09-93
		WO-A-	9315248	05-08-93
EP-A-0007802	06-02-80	JP-A-	55098956	28-07-80
		JP-C-	1370785	25-03-87
		JP-A-	55021420	15-02-80
		JP-B-	61037380	23-08-86
		US-A-	4296163	20-10-81